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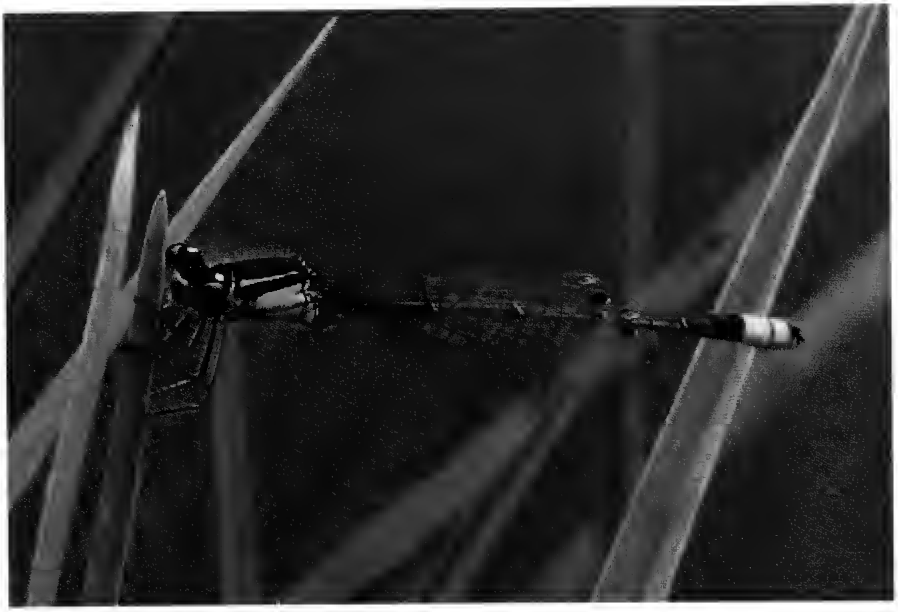

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From the Editors

An unfortunate incident at the premises of the Field Naturalists Club of Victoria has reminded us of the fragility of the resources we too often take for granted. A fire in the kitchen on 17 June caused extensive damage to the adjacent hall space, and had a diminishing impact on rooms further away. One of those rooms houses the Library and Archives of the FNCV, a place of particular importance in the continuing production of the Club's journal. No recent issue of this journal has been compiled without resort, usually on a number of occasions, to information held in the Library.

But for the good fortune of the fire being noticed and reported at an early stage, those invaluable sources of information would have been lost. The closeness with which we came to losing it all has been a salutory experience, and underlines how impermanent such records are. This is perhaps less so for those records that have been published, which points to the great value of journals as long-standing as this one. One of the most important roles fulfilled by *The Victorian Naturalist* is in giving a wide range of records a more lasting form.

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Front cover: Male *Common Bluetail*. Photo by Virgil Hubregtse. See page 138.
Back cover: Female *Common Bluetail*. Photo by Virgil Hubregtse. See page 138.

Microbial implications associated with stomach flushing of Little Penguins

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Abstract
The stomach flushing technique is a vital tool in bird dietary studies. The technique requires a tube to be inserted into the penguin's mouth and passed through the oesophagus to the stomach. General practice does not include cleaning of the tube between penguins. This report investigates if the stomach flushing tube can be a vehicle to transmit potential pathogens from a sick penguin to a healthy penguin, and if implementation of aseptic or disinfection practice is warranted in the stomach flushing technique. A total of 19 tubes from 19 penguins were examined for bacterial presence from May until August 2007. This paper presents new recommendations for stomach flushing procedures from a microbial perspective to ensure that birds subjected to this are not jeopardised by practices that may promote the transfer of potential pathogens from one penguin to another. (*The Victorian Naturalist* **128** (4), 2011, 128–131)

Keywords: *Eudyptula minor*, stomach flushing, microbes, Little Penguins

Introduction

Seabirds are excellent indicators of the health of the marine ecosystem (Barrett *et al.* 2007). For example, the monitoring of seabird diet can provide data on fluctuations in fish populations (Barrett *et al.* 2007). The identification of critical prey items and monitoring of seabird diets are of significant importance in understanding and managing their ecological requirements (Deagle 2007; Gales 2007). Many different methods are used to determine the critical prey items in the diet of seabirds, from direct feeding observations, emetics, the collection of regurgitated pellets, and the observation of stomach samples from carcasses (Barrett *et al.* 2007); however, some of these techniques are considered to be either lethal (Sieburth 1959), highly stressful to the bird or difficult to employ due to the feeding ranges of seabirds. Therefore, in 1984 Wilson described an improved method for stomach flushing of penguins. This technique now has been used extensively to obtain stomach contents from a range of birds (Chiaradia *et al.* 2003; Gales, 1987; Neves *et al.* 2006; Randall and Davidson 1981). The method requires a latex tube to be passed through the oesophagus of a bird to its stomach. Once inserted, water is pumped (either via a water pump or syringe) into the bird's stomach, the bird is inverted and pressure is placed on the bird's stomach to induce regurgitation. This method can be repeated many times until the returning water is clear of regurgitates (Gales 1987; Wilson 1984). This procedure has allowed scientists to acquire more comprehension of the ecological requirements of seabirds (Deagle *et al.* 2007); however, certain limitations were identified by researchers with this technique and modifications made (Chiaradia, *et al.* 2003; Gales 1987; Preston 2008). Limitations identified included a limit on the number of times an individual could be flushed (e.g. maximum of three flushes per penguin), assessment of stomach index (indicates the availability of space in the stomach) and a restriction on the amount of water that could be injected into the penguin's stomach (Preston 2008).

Data obtained at the 6th International Penguin Conference indicated that most penguin biologists (80%, n=10) do not implement a cleaning regime (e.g. disinfection of stomach flushing tube) or aseptic practice (e.g. sterilised tube per penguin) when flushing penguins (pers. obs. Andrea Chiaradia, Knowles Kerry, and Tiana Preston pers. comm.). Penguins have been known to be infected by a range of pathogens (e.g. *Pasteurella multocida* and *Corynebacterium*), which in some cases are responsible for high mortality rates post infection

(DeLisle *et al.* 1990; Leotta *et al.* 2006; Murray and Houston 2005; Williams and Ward 2002). This documentation is of concern as the tube with which the stomach is flushed may act as a vector for cross contamination from penguin to penguin. This study investigated whether bacteria can be transferred from one penguin to another by documenting the presence of bacteria on the tube used on free ranging little penguins. Furthermore, the efficiency of different disinfectants for potential use in the field to clean tubes between animals was tested. This paper also presents new recommendations for the stomach flushing technique from a microbial perspective to ensure that birds subjected to this procedure are not jeopardised by practices that may promote the transfer of bacteria from one penguin to another.

Site and Sampling

Data were collected opportunistically during May (N=7) July (N=7) and August 2007 (N=5) on free ranging penguins as part of a study on the diet of little penguins at the St Kilda Breakwater (Melbourne, Victoria) (Preston 2008). This collaboration allowed us to collect microbial data opportunistically from the stomach flushing tube used on penguins without causing additional stress to the penguins. A total of 19 individual penguins were captured and flushed. The stomach flushing procedure implemented during the dietary study followed Wilson (1984) and included the modifications outlined by Chiaradia *et al.* (2003) with the addition of 1) determination of stomach index, and 2) the replacement of a water pump with 140 ml syringes (Preston 2008). During May, swabs were taken from the tubes used for stomach flushing before the procedure and immediately after the tube was removed from each penguin. There was no cleaning regime implemented during this field trip (i.e. the tube was not cleaned between penguins); however, a cleaning regime (disinfection) was introduced. During the July field trip a 1% aqueous sodium hypochloride solution commonly used to disinfect babies bottles (Milton) was trialled, and in August a commonly used Veterinary disinfectant (F10SC) was trialled on the cleaning tube. The cleaning regimes implemented in this study required the tube used to flush stomachs to be soaked in either the Milton Antibacterial solution or F10SC for five minutes before being used on another penguin (i.e. after completion of stomach flushing). After disinfection, the tube was rinsed internally and externally with distilled water to remove any residue before re-use and to ensure the disinfectant did not cause an impact on natural microflora of these penguins. A swab was then collected from the tube to determine the effectiveness of the disinfection treatment.

Bacterial cultures were grown on Horse Blood, MacConkey, and nutrient agar and incubated at 37°C for 48 hours. Quantification of the total number of bacterial colonies was conducted based on gram stains (May and July) and morphological characteristics (all months). No gram stains were conducted on specimens collected in August. Disinfection in this study was defined as the removal of at least 80% of all colony forming units of all bacterial species.

Results

Presence of bacteria on stomach flushing tube

Fourteen penguins were sampled during the months of May and July. In total, 80 distinctive species of bacteria were obtained from tubes. The mean number of different bacteria found per tube per penguin was 5.5 (S.D. =0.5; N = 14). The mean number of gram negative bacteria found on the tube was higher (May: Mean = 2.3, S.D. =1.25; N =7; July: Mean =2.14; S.D. =0.7 ; N =7) than gram positive species (May: Mean =0.6 ; S.D. =0.53 ; N =7 ; July: Mean =1.14; S.D. =1.07; N =7).

Trial of Disinfectants

Before tube disinfection the mean number of morphologically distinct bacteria found on the tube was 3.4 (S.D. =1.25; N =7) in the month of July, and 5.5 (S.D. = 2.65; N = 5) in the month of August. Cultures from samples collected immediately after disinfection, did not grow any bacteria (Fig. 1). Both Milton and F10SC were 100% effective in removing bacteria from the tubes used for flushing in the field ($F = 84$, $P = <0.01$; $F = 17.286$, $P = <0.001$) respectively (Fig. 1).

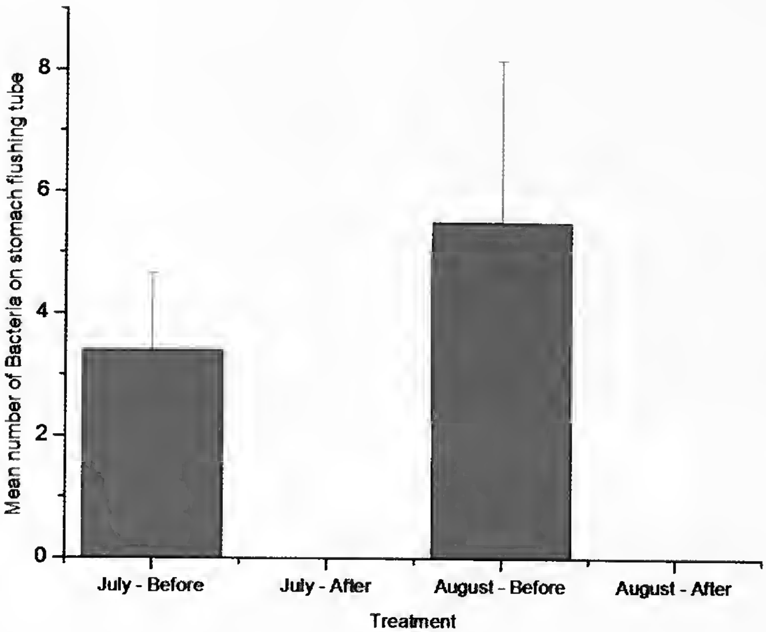

Fig. 1. The mean number of bacteria present on the stomach flushing tube pre- and post cleaning with Milton (July) and F10SC (August). N represents total number of bacteria found on the tube pre-flushing for each month.

Discussion

Penguins are susceptible to infectious diseases (Boerner, *et al.* 2004; Broman, *et al.* 2000; Clarke and Kerry 1993; Clarke and Kerry 1999; Goyache, *et al.* 2003; Leotta, *et al.* 2006; Murray and Houston 2005; Thouzeau, *et al.* 2003; Zdanowski, *et al.* 2004) including Avian Cholera *Pasteurella multocida,* and Avian Diphtheria *Corynebacterium,* which have been responsible for high rates of mortality in penguin and seabird colonies (DeLisle *et al.* 1990; Leotta *et al.* 2006; Murray and Houston 2005; Williams and Ward 2002). Results from this study demonstrate that bacteria adhere to the tube(s) used to flush stomachs and, therefore, have the potential to transmit bacteria from one individual to another when the tube is used multiple times without disinfection. In light of these results, it is suggested that aseptic practice become routine in the technique of stomach flushing. Results demonstrated that the two disinfectants selected were effective at removing bacteria in the field. Furthermore, the two disinfectants were inexpensive, simple to use, time efficient and safe to use in the field without compromising research objectives. Alternatively, tubes could be sterilised (e.g. autoclaved) in the laboratory before fieldwork and each penguin could be flushed using a different tube.

Furthermore, aseptic/disinfection application should not be limited to penguins exclusively, but to any animal subjected to stomach flushing. This could be of fundamental importance to endangered and threatened bird populations that are subjected to this procedure, such as the Yellow-eyed Penguins *Megadyptes antipodes* (Moore and Wakelin, 1997), the Royal Penguin *Eudyptes schlegeli* (Horne 1985), the Southern Rockhopper Penguin *Eudyptes chrysocome chrysocome,* the Northern Rockhopper Penguin *Eudyptes chrysocome moseleyi* (Horne 1985; Ray and Schiavini 2005), Wandering Albatrosses *Diomedea exulans,* (Cooper *et al.* 1992; Xavier

et al. 2003) and the White-chinned Petrel *Procellaria aequinoctialis* (Cooper *et al* 1992) to ensure that these species are not jeopardised by dietary studies that utilise the stomach flushing technique.

Although further analysis needs to be conducted for identification and quantification purposes, the results have demonstrated the presence of bacteria on the tubes used for stomach flushing. Because medical equipment can become contaminated with infectious microorganisms after any procedure, the Therapeutic Goods Administration of Australia (TGA, 2004) states that all medical equipment must be decontaminated before reuse to prevent the transmission of microorganisms from one individual to another. Therefore, as a precautionary measure, researchers should consider either using individually sterilised tubes for each penguin or disinfecting the tube used for stomach flushing between birds.

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Observations of repeated refuge use by the Little Whip Snake *Parasuta flagellum* (Elapidae)

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Abstract
Examples of individual Little Whip Snakes *Parasuta flagellum* being located beneath the same day-time refuge after periods of five months or more (spanning all or part of the species' active season) are described. Observations suggest that some individuals have preferred refuges to which they return. (*The Victorian Naturalist* **128**(4), 2011, 132-136)

Keywords: *Parasuta flagellum*, basalt, grasslands, stone, refuge

Introduction

The Little Whip Snake *Parasuta flagellum* is a small, lizard-eating, nocturnal elapid snake commonly encountered during the day beneath surface stones on the basalt plains grasslands to the north and west of Melbourne (James 1979; Fyfe and Booth 1984; Turner 1989). During the coolest months of the year, from approximately May to September, *P. flagellum* are generally inactive and remain beneath the same stone (Turner 1989, unpubl. data). During the species' active season (October to March) when either sloughing is imminent or conditions are unusually cool, they tend also to remain beneath the same stone but for shorter periods (pers. obs.). In addition, gravid female *P. flagellum* have been recorded occupying the same refuge for several months at a time during summer (Turner 2001). In this paper, examples are described of *P. flagellum* being located more than once beneath the same day-time refuge over periods of time that include the species' active season. The examples indicate that some individuals have a tendency to return to refuges that they have previously occupied.

Methods

Observations occurred between 1991 and 1995 during field surveys in grasslands at three sites situated to the north and west of Melbourne: Bundoora (37°42'S, 145°03'E), Craigieburn (37°38'S, 144°58'E) and Deer Park (West) (37°46'S, 144°46'E). Since the objective of the surveys was to collect census data on *P. flagellum* over many sites, rather than the mark-recapture of individuals, the observations described below resulted from limited repeated sampling at these sites. Snakes were located beneath stones in grasslands during daylight hours. The maximum linear dimensions of the stones (length × width × thickness) were measured with a flexible tape measure (± 10 mm), and the substrate type was noted. Snout-to-vent length (SVL) and tail length (TL) were measured using a 500 mm rigid laminate ruler (± 1 mm). For some, but not all individuals, head length (HL: the distance along the mid-line from the tip of the rostral scale to the furthest point of contact of the two parietal scales) was measured with a vernier calliper (± 0.02 mm) and mass (M) was determined using an Ohaus Cent-o-Gram balance (± 0.1 g). As repeated measurements of the same individual were taken at different times, sets of measurements were deemed to be the same if they were within ± 5 mm for SVL and TL and ± 0.2 mm for HL. In addition, the following characteristics were recorded for each snake: sex (by visual inspection of the tail; see Turner 1992), ventral colouration, the type and location of ventral scute anomalies and injuries. A sketch was made of the top of the head showing the arrangement of the large head scales and the distribution of black pigment on the head and snout. Previous work (Turner 1989, 1998, 2001) with this species indicated that these characteristics were sufficient to identify individual snakes. Snakes were deemed to be 'adult' if SVL exceeded 205 mm for males and 232 mm for females, based

Table 1. Details of the nine examples of repeated refuge use in the Little Whip Snake *Parasuta flagellum* detailed in the text. Refuge size refers to the maximum linear dimensions in metres. Abbreviations for substrate types: L = Loam; C = Clay; S = Stone; G = Grass (dry).

Example	Size Class/ Sex	Initial – Recapture Dates	Refuge Size: length × width × thickness; substrate type	Approx. Time interval (months)	Same refuge?; Distance to same refuge	Growth?
1	Sub-adult male	29/5/93	0.51 × 0.28 × 0.16; L			
		– 7/5/94	0.22 × 0.18 × 0.09; C	11	N; 2 m	Y
2	Adult male	18/7/92 – 26/6/93	0.39 × 0.24 × 0.11; C	11	Y	Y
3	Adult female	4/6/94 – 3/6/95	0.31 × 0.29 × 0.06; C	12	Y	N
4	Adult male	17/8/91 – 18/7/92	0.43 × 0.48 × 0.20; C	11	Y	N
5	Adult female	20/9/92 – 13/5/95	Iron sheet 0.5 × 0.3; G	32	Y	N
6	Adult female	15/8/92 – 6/3/93	0.75 × 0.68 × 0.07; S	7	Y	N
	Adult male	15/8/92 – 6/3/93	0.75 × 0.68 × 0.07; S	7	Y	–
7	Adult male	24/5/92 – 3/3/93	0.60 × 0.35 × 0.08; S	9	Y	N
		– 7/8/93	0.36 × 0.17 × 0.14; S	5	N; 3 m	N
		– 29/5/94	0.60 × 0.35 × 0.08; S	9	Y	N
	Adult female	24/5/92 – 7/8/93	As above	14	Y	N
8	Adult male	29/2/92 – 18/7/92	0.60 × 0.53 × 0.18; C	5	Y	N
9	Adult male	17/8/91 – 13/6/92	0.41 × 0.40 × 0.08; C	10	Y	–

on data provided in Shine (1988), 'juvenile' if SVL was less than 180 mm, and 'sub-adult' if SVL was between these size limits.

Observations

The nine examples described below involved snakes being found beneath a stone they had previously occupied, or another stone very close to it (< 3 m), after periods of five months or more that included at least part of the species' active season. These examples are summarised in Table 1.

1. Darebin Creek, Bundoora. On 29/5/1993 an adult female (SVL 265 mm, TL 37 mm, HL 10.0 mm, M 16.5 g) and sub-adult male (SVL 198 mm, TL 40 mm, HL 8.9 mm, M 8.7 g) were found several centimetres apart beneath a stone resting on loam soil on sloping ground. The refuge and surrounds were inspected seven times during spring and summer but neither snake was located. The male was found again almost a year later beneath a stone at the base of a grass tussock less than 2 m from the original stone. It measured: SVL 240 mm, TL 50 mm, HL 9.7 mm, M 13.5 g, corresponding to an 18, 20, 8 and 36% relative increase in each respective measurement.
2. North of Robinsons Road, Deer Park. On 18/7/1992 an adult male (SVL 370 mm, TL 60 mm) was located beneath a stone resting on damp clay. This stone formed part of pile that had evidently been gathered from surrounding paddocks. The snake was not located on two visits during the active season but was located the next winter beneath the same stone. It measured: SVL 380 mm, TL 60 mm, representing a 3% relative increase in SVL.
3. North of Robinsons Road, Deer Park. On 4/6/1994 two adult females (#1 SVL 294 mm, TL 37 mm, HL 11.1 mm; #2 SVL 290 mm, TL 40 mm, HL 11.6 mm) were located beneath a partially imbedded stone on the side of a small gully. A further two visits failed to locate either snake beneath this or nearby stones. About a year after the original observation, three adult *P. flagellum* (one male and two females) were found in direct body contact beneath the original stone. One of the females was #1 and measurements indicated that no growth had occurred.
4. Clarkes Road, Deer Park. On 17/8/1991 an adult male (SVL 295 mm, TL 63 mm) was located overwintering beneath a stone on a dry clay substrate. This stone was on the edge of stone pile in the middle of a paddock beneath a small stand of Sugar Gum *Eucalyptus cladocalyx*. A visit during the summer months failed to locate the specimen. It was located again nearly a year after the original observation beneath the same stone with an adult female (SVL 259 mm and TL 31 mm). No growth was evident.
5. Darebin Creek, Bundoora Park. On 20/9/1992 an adult female (SVL 274 mm, TL 36 mm)

was found beneath a concave sheet of corrugated iron resting on a dry grassy mat beneath a stand of Black Wattle *Acacia melanoxylon*. A further four visits made over the next two years failed to locate the specimen. Two years and eight months after the original observation the specimen was located beneath the same sheet of iron. No growth was evident and the distal third of the tail was missing; this injury was not recent.

6. South of O'Herns Road, Craigieburn. On 15/8/1992 an aggregation consisting of two adult females (#1 SVL 370 mm, TL 45 mm; #2 SVL 310 mm, TL 28 mm) and a male (that escaped) all in direct body contact was found beneath a broken slab of exfoliating basalt. The aggregation was observed again on the 24/10/92 but was not disturbed. Seven months after initially being located, the male and female #1 were still present beneath the exfoliation. The female appeared to be post-parturient; this was indicated by the presence of a lateral skin fold along the posterior third of the body and palpated 'hollow' abdomen. No growth was evident in the female.
7. North of O'Herns Road, Craigieburn. On 24/5/1992 an adult male (SVL 340 mm, TL 57 mm, HL 11.0 mm) and small adult female (#1 SVL 235 mm, TL 27 mm, HL 6.2 mm) were located 0.2 m apart beneath a fractured slab of exfoliating basalt consisting of three loose and a fourth immovable piece. On the next visit (3/3/1993) only the male was located. On 7/8/1993 female #1 was present, along with a second adult female (#2 SVL 320 mm, TL 38 mm, HL 10.9 mm); 3 m away, beneath a smaller stone, was the male. No growth was evident in either snake. On 20/11/1993 female #2 (no measurements taken) was located beneath the slab, while the male and female #1 could not be located. On 12/2/1994 only one snake, a gravid female (#3 SVL 263 mm, TL 32 mm, HL 6.9 mm) was located beneath the slab; a relatively fresh adult slough was located within centimetres of where she lay. On the final visit (29/5/1994), three snakes were beneath the slab: the male, female #3 and another female which escaped beneath the immovable piece of the slab (very likely female #2 based on snout pigment). No growth was evident in either the male or female #3.
8. North of Robinsons Road, Deer Park. On 29/2/1992 an adult male (SVL 318 mm, TL 62 mm) was located in pre-slough condition beneath a stone on cracked clay soil. It was located a week later, having sloughed (though there was no sign of the skin), and located again in mid-winter beneath the same stone. No growth was evident.
9. North of Robinsons Road, Deer Park. On 17/8/1991 an adult male (SVL 330 mm, TL 60 mm) and female (SVL 315 mm, TL 40 mm) were located intertwined beneath a stone situated in a swathe of Kangaroo Grass *Themeda triandra*. A further three visits to the site failed to locate either snake. The following year at the start of winter only the male was located beneath the same stone (and remained there over winter). No follow-up measurements were made.

In addition to these observations, at least another 11 snakes (other than gravid females) were found beneath a previously occupied stone during the active season after time intervals between three and 13 weeks. These additional observations comprised nine adults (six females, three males), one sub-adult (male) and one juvenile (female). Four of these observations involved snakes being located beneath the same stone on three separate occasions, while the remainder was located twice.

Discussion

The observations suggest that some *P. flagellum* return to day-time refuges they have previously occupied and therefore do not move about their habitat in a completely random way. The probability of locating the same individual snake beneath the same stone following periods of five or more months would appear to be very small, as there are apparently suitable refuges not only in the immediate vicinity, but also in the wider area where observations occurred, as indicated by the presence of many other *P. flagellum* beneath stones. Individual snakes were not completely sedentary between observations as in some instances they were not located beneath the original refuge in (one or more) follow-up visits to sites (Examples 1-5, 7, 9). Furthermore,

sites were checked only by day, whereas *P. flagellum* are known to be predominantly nocturnal (Fyfe and Booth 1984; Wilson and Knowles 1988; Coventry and Robertson 1991; Ehmann 1992) though limited diurnal activity does occur; (Turner 1998, 2001) and therefore night-time activity away from refuges cannot be excluded. Five of the examples (1-4, 9) recorded snakes beneath the same refuge in successive winters, possibly indicating fidelity to particular overwintering refuges. Additional observations indicate that particular stones were 'favoured' by *P. flagellum*, and that on almost every visit they were occupied, though not necessarily by the same individual (pers. obs.). Basalt exfoliations were almost always occupied by *P. flagellum*, but were not common at any of the sites compared to stones that lay directly on soil.

It is possible that disturbance by the observer may have influenced the movements of *P. flagellum*, and caused them to move from a refuge and remain away from it. It was generally observed that during the species' inactive season snakes tended to remain beneath the same refuge while those located during the active season tended to vacate refuges. This trend may be explained simply by conditions being less suited to movement during the colder months compared to the warmer months; however, movement during the warmer months might also be due to disturbance. While more frequent sampling may have resulted in clearer patterns of movement, it also may have influenced these patterns unduly.

As all snakes except one in the examples above were adults, and the time interval between the initial and the final observations were typically around one year or less, it is not surprising that little or no growth was recorded. The most substantial growth recorded was in a sub-adult male (Example 1).

Given the relatively small size of many basalt plains grassland reserves and remnants (DCE 1990; McDougall and Kirkpatrick 1994) and the close association that *P. flagellum* (and other reptile species) have with basalt outcrops within these areas, it is important that the extent of movement and home-range size of species such as *P. flagellum* be determined in order to better inform land managers about the conservation needs of these species. Home-range size is known in only a small number of Australian elapid snakes and in these species there is a pattern for males to have considerably larger home ranges than females (Webb and Shine 1997, Fitzgerald *et al.* 2002, Whitaker and Shine 2003). For example, male Eastern Brown Snakes *Pseudonaja textilis textilis*, which are common inhabitants of some northern basalt plains grasslands, have been determined to have a mean home-range size of 11.8 ha while for females it was 1.5 ha (Whitaker and Shine 2003). Whether these home-range sizes determined from *P. t. textilis* populations inhabiting rural NSW are applicable to other populations in different habitats is not known. A species that is similar to *P. flagellum* in terms of size, activity period and diet is the Eastern Small-eyed Snake *Rhinoplocephalus nigrescens* and its movements have been extensively studied (Webb *et al.* 2003, Keogh *et al.* 2006). Male *R. nigrescens* moved over larger distances than females, with the mean straight-line distance between capture and recapture being 99 m for males (0 – 346 m) versus 35 m for females (0 – 140 m); 55% of females were recaptured within 20 m of their original location, six were located beneath the same stones and some used the same stone each year during the reproductive season. A study of *P. flagellum* that focuses on the movements of individual snakes would not only enable home-range size to be determined, but could also clarify the extent of repeated refuge use documented in this work.

Acknowledgements
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One Hundred and twenty-seven Years Ago

Notes on Victorian venomous snakes

by
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(Read 21st April, 1884)

Venomous snakes destroy their prey by poison. Some, such as the Copper-headed, when they have caught and bitten an animal, commence swallowing it at once, while yet alive, but the Tiger Snake does not touch its prey after it has bitten it until life is quite extinct. When swallowing, the jaws are moved alternately. This is possible from the freedom of movement which is obtained by all the bones of the head being united by elastic ligaments, so that the head and jaws can stretch considerably. Hence also snakes can swallow prey apparently larger than themselves. Occasionally two snakes will seize upon the same prey, and as neither will give way, the larger swallows the lesser, until the latter is compelled to relax its hold on the prey and withdraw from the contest. I lately heard of a case where a large snake had swallowed a smaller one in the manner described, but the latter had gone too far down to be able to recede, and died, and when the larger snake was opened, it was found to have partially digested its opponent, only the tail remaining uninjured. The Tiger Snakes and Death-adders generally prefer mice and rats. Rats do not succumb readily to the poison, and take a long time to die. Lately I saw a small native cat bitten severely by three large Tiger Snakes, with about five minutes' interval between each bite, and it took an hour and a half to die. The other snakes prefer frogs as an article of diet ...

Snakes shed their teeth, new ones being rapidly produced. There are always a number of immature fangs behind the two in use, and if these are destroyed by any accident, another pair will be fully developed and ready for use in about six days. The point of the fang is extremely fine and solid, the tooth being perforated in its lower three-fourths. The channel is enamelled. The fangs of all our snakes are permanently erect, and when the mouth is closed, fit into a depression in the lower jaw. The jaws do not close on each other, but also fit into depressions.

If frightened during a meal, snakes sometimes disgorge. I once saw a Tiger Snake kill and swallow five mice in succession. Finding that they were more than could be managed, it retained only three. The digestion is good, and probably assisted by the venom injected, as it has been shown recently that it possesses peptic qualities.

From *The Victorian Naturalist* **I**, pp 27, 28, April, 1884

Hilary Weatherhead
1926 – 31 March 2011

Hilary Weatherhead, who died on 31 March 2011, aged 85, was elected to the Field Naturalists Club of Victoria in October 1975, and quickly involved herself in the activities of the Club. As a botanist, she joined the Botany Group, of which she was Chairperson for eight years, between 1981 and 1989; a committee member for another year; and briefly, in 1993, joint secretary. Between 1981 and 1996 she gave 19 talks to the Botany Group, on topics as diverse as plants of the southern Dandenongs, the Darling Range and Sand Plains of Western Australia, to the Swiss Alps and Kashmir. She also led excursions to various parts of Victoria, including Warburton, French Island, Black Rock (seaweeds), Mt Donna Buang, French Island and the Upper Thomson.

In the 1980s the Botany Group undertook the conservation of Courtney's Road, Belgrave South, where there was a significant collection of orchids in the roadside vegetation, and Hilary, together with Ilma Dunn and other group members, was very active in this project, and reported regularly on progress there. She also contributed to General Meetings, with talks, exhibits and nature notes. These talks dealt with plants in particular localities, such as Willsmere Park, and in different habitats. The effect of drought on plants, and their regeneration after bushfires, particularly after Ash Wednesday, were other topics.

Hilary developed a keen interest in fungi, and it is in this capacity that she is most remembered. Her talk to the Botany Group in May 1991 was entitled 'An introduction to fungi', and many people will remember going on excursions with her, some of which she led. As a novice I remember asking her on one excursion how she remembered all the names and distinguishing features of the many and diverse species, to which she replied encouragingly 'Every time a little more sticks!' In 1989 she exhibited a fungus she had found in Sherbrooke Forest, thought to be a rare species of *Mutinus*. This was later confirmed as *Mutinus certus*, a sub-tropical species. After she and husband Peter retired to the Dandenongs she became known locally as 'the fungi lady of Emerald', always ready to identify specimens or photos.

As well as contributing so much in her own particular field, Hilary undertook other responsibilities within the Club. She was a member of Council from 1980 to 1984 and, following the crisis of the sudden resignation of both the Editor and Sub-editor of *The Victorian Naturalist*, she willingly became a member of the administrative committee created to keep the journal appearing until another editor was appointed. She held the position of Programme Secretary, responsible for arranging speakers for the monthly General Meetings. This was a task Hilary carried out most conscientiously, not only making sure that we had an interesting and varied programme throughout the year, but also that the people invited were good speakers. On one occasion she was very anxious because she did not know anything about the speaker. She need not have worried. We had one of the most fascinating evenings, on the subject of eels!

Hilary also served as a member of the Award Committee for the Australian Natural History Medallion from 1986 to 1990.

I am indebted to Jill Weatherhead for information about Hilary's reputation in Emerald.

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Ovipositing Odonata: dragonflies and damselflies at a flood-retarding basin

Introduction

The afternoon of 9 February 2011 was pleasantly warm, calm and sunny, so I decided to go for a walk around the flood-retarding basin in the north-east section of Monash University's Clayton campus, in suburban Melbourne. The basin, some 200 m long and approximately 80 m across at its widest point, is always interesting to visit, and this time I was about to see something special.

Egg-laying 'Emperors'

Just above the surface of the water, a profusion of rapidly beating translucent wings shimmered in the sunlight: hundreds of pairs of Australian Emperor dragonflies *Hemianax papuensis* (Aeschnidae) were engaged in the process of laying their eggs in the eelweed Giant Val *Vallisneria gigantea*. Rings of tiny ripples encircled the females' abdomens where they entered the water (Fig. 1). But, although intent on producing the next generation, these insects could not devote their attention exclusively to this activity, because peckish Pacific Black Ducks *Anas superciliosa* swam amongst them, snapping up any that were too slow to escape (Fig. 2).

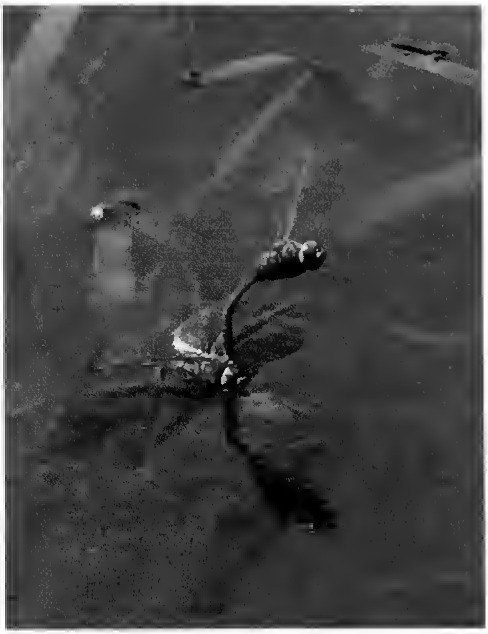

Fig. 1. Australian Emperors

Fig. 2. Pacific Black Duck eating Australian Emperor

In Australian Emporer dragonflies—and some other dragonfly and damselfly species—the male guards the female while she lays her eggs, so the pairs remain attached in 'tandem position' after mating (Fig. 1). Sites are selected where the female can lay her eggs directly into plant tissue (Brisbane insects web site; Ian Endersby pers. comm. 14 March 2011). If some vegetation protrudes above the water at the chosen site, the male will use it for support (Theischinger and Hawking 2006 photo p. 15; pers. obs.). If the female stops beating her wings for any reason—for instance if she sinks low in the water—the male beats his faster to compensate (pers. obs.).

Reproduction and life cycle

Dragonflies and damselflies have a unique method of reproduction. The male has two sets of genitalia, the first on the ninth abdominal segment and the second on the second abdominal segment. Before copulation, the male, which is able to bend his abdomen so that the two sets of genitalia touch, transfers sperm to his secondary genitalia. He clasps the female on the occiput (back of the head—dragonflies) or prothorax (neck—damselflies), first with his legs then with the appendages on the tip of his abdomen. Then the female curls her abdomen so that her genitalia contact the male's secondary genitalia, and sperm is transferred to

her storage sacs. This mating configuration is known as the 'wheel position'. Dragonflies and damselflies can fly in this position as well as in tandem (Zborowski and Storey 2003).

The female uses the stored sperm to fertilise her eggs as she lays them. Female dragonflies lay large numbers of eggs—from 400 to 2000, depending on the species. Those that lay in the water produce more eggs that those that lay in plant tissue or mud (Theischinger and Hawking 2006). All damselfly species lay their eggs in plant tissue. Generally the eggs are not all laid at once, but in batches (Ian Endersby pers. comm. 19 February 2011).

After a larva emerges from an egg it goes through several development stages (instars), feeding on aquatic invertebrates such as the larvae of other insects. The final instar moves out of the water on to a plant, log or rock and the adult emerges from its larval skin. This development process can take from two months to 10 years, depending on the species and the water temperature (Brisbane insects web site). After the adult emerges, it leaves the water for the following one to four weeks, during which time its colour develops and it reaches sexual maturity. Depending on the species, mature adults either return to their natal water body or visit a number of water bodies. Males select a territory where they wait for females to arrive (Theischinger and Hawking 2006). The adults live for about seven to ten weeks (Brisbane insects web site).

Male dragonflies can be very aggressive. They attack each other when defending their territories, sometimes damaging their wings in the process. In some species the males will even attack females that are laying eggs. A male can remove sperm from a female that has previously mated with another male, replacing it with his own (Brisbane insects web site; Ian Endersby pers. comm. 19 February 2011). I noticed some single Australian Emperors attack pairs while the females were laying eggs, but these challenges appeared to be unsuccessful.

More dragonflies

The spectacle I witnessed on 9 February inspired me to visit the basin frequently during February and March. Although I saw no repeat, I was delighted to find three more species of dragonfly: Blue Skimmer *Orthetrum caledonicum* (Libellulidae) (Figs. 3, 4, 5), Wandering Percher *Diplacodes bipunctata* (Libellulidae) (Fig. 6) and Tau Emerald *Hemicordulia tau* (Hemicorduliae) (Fig. 7).

Fig. 3. Male Blue Skimmer guarding territory

Fig. 4. Blue Skimmers mating

Fig. 5. Male Blue Skimmer on bird dung

Fig. 6. Male Wandering Percher guarding territory

Fig. 7. Tau Emerald

In the Tau Emerald, as in the Australian Emperor, mature adults of both sexes are similar in colour, whereas in the Blue Skimmer and Wandering Percher they are different colours—but old female Blue Skimmers develop the powdery blue colour (Brisbane insects web site), and well developed mature male Wandering Perchers can be yellow instead of red (Ian Endersby pers. comm. 18 February 2011). In mature Tau Emeralds the black colour on the upper abdomen shines emerald green when at a certain angle to the light. In a very similar species, the Australian Emerald *H. australiae*, mature adults have emerald green eyes as well as the sheen on the abdomen (Brisbane insects web site).

Australian Emperors and Tau Emeralds spend most of their time on the wing. Tau Emeralds often hover in the same place for a few seconds—a feature that, along with their smaller size, distinguishes them from Australian Emperors. By contrast, male Blue Skimmers and Wandering Perchers perch frequently while guarding their territories. Generally they choose vegetation close to the water (Figs. 3 and 6), but both species often land on light-coloured objects such as dead leaves, or white areas on coloured cardboard, and Blue Skimmers sometimes alight on white spots of bird dung (Fig. 5), rocks and other objects (pers. obs.).

Blue Skimmers and Tau Emeralds mate for only a short time, after which the pairs separate and the females lay their eggs alone (Brisbane insects web site). Some pairs of Blue Skimmers I observed (Fig. 4) mated for about 90 seconds rather than 2-4 seconds as stated on the Brisbane insects web site. The Tau Emeralds mated for several minutes, half hidden in vegetation such as bulrushes *Typha* sp. or shrubs. I missed seeing the females of both species lay their eggs because I lost sight of them soon after they flew away.

Wandering Perchers remain in tandem after mating. They fly low over the water, and the female frequently dips the end of her abdomen in, 'washing' off her eggs (Brisbane insects web site; Ian Endersby pers. comm. 18 February 2011). At the basin, hungry hordes of the introduced Mosquitofish *Gambusia* sp., a major pest in Australia (Australian Museum web site), gathered around and followed the laying females, devouring the eggs as they were laid (pers. obs.). Despite their name, Mosquitofish do not eat many mosquito larvae (Australian Museum web site), but they attack and kill dragonfly larvae (Calam Vale Creek web site).

Dragonflies, on the other hand, are considered beneficial insects because they do eat mosquitoes (Zborowski and Storey 2003): the larvae eat mosquito larvae, and the adults eat adult mosquitoes (Mosquito world web site) as well as other types of insects. Dragonflies' and damselflies' big eyes have almost 360° vision, excellent for detecting prey.

Damselflies

I was thrilled to find six beautiful damselfly species at the basin: Blue Ringtail *Austrolestes annulosus* (Lestidae) (Fig. 8), Wandering Ringtail *Austrolestes leda* (Lestidae) (Fig. 9), Red and Blue Damsel *Xanthagrion erythroneurum* (Coenagrionidae) (Fig. 10), Eastern Billabongfly *Austroagrion watsoni* (Coenagrionidae), Aurora Bluetail *Ischnura aurora* (Coenagrionidae) (Fig. 11) and Common Bluetail *Ischnura heterosticta* (Coenagrionidae) (front cover, back cover). These insects spent much of their time in the vegetation near the water but, because of their small size, delicate structure, infrequent movements and wary nature, they were not as easy to observe as their more conspicuous cousins.

Male Blue Ringtails and Wandering Ringtails remain with the female during egg-laying (Esperance wildlife web site—Blue Ringtail (photos); Brisbane insects web site—Wandering Ringtail), but during my brief sightings I saw none of this behaviour. Red and Blue Damsels mated in the grass, then flew over the water where the male remained in tandem with the female while she laid her eggs in the eelweed. This was the only species of damselfly I managed to see laying eggs. I found a pair of Eastern Billabongflies mating, but unfortunately I disturbed them and they quickly disappeared from view after flying away in the 'wheel position'. Common Bluetails were visible on numerous occasions, but I didn't see the sexes interact. I discovered one female

Fig. 8. Male Blue Ringtail

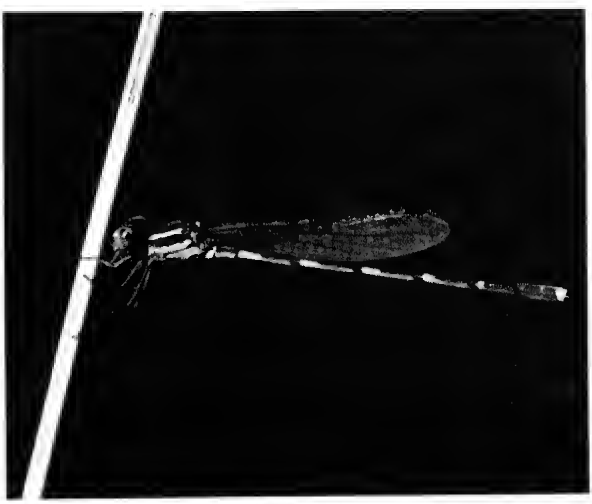

Fig. 9. Male Wandering Ringtail

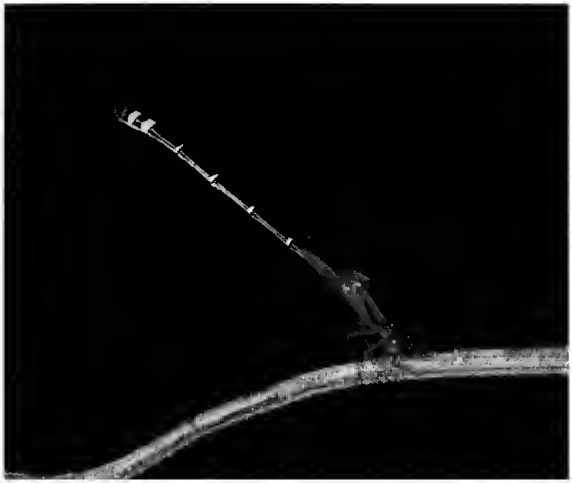

Fig. 10. Male Red and Blue Damsel

eating another damselfly (possibly an Aurora Bluetail), one eating a fly, and two in egg-laying posture — one on a blade of grass, and the other on a dry plant stem.

Fig. 11. Male Aurora Bluetail

Conclusion

The recent wet summer has been favourable for the Odonata, and many people have commented on the abundance of dragonflies. I have been fortunate to experience the excitement of watching just ten of Australia's 324 species of these fascinating insects close to where I live. It will be interesting to note how the populations at the basin fare next year, because Mosquitofish, which are very prolific breeders, are already present in huge numbers.

Acknowledgements

Many thanks to Ian Endersby for answering my questions about dragonflies and damselflies, and suggesting sources of information. Thanks also to Ricardo San Martin, School of Biological Sciences, Monash University, for identifying the Mosquitofish and the water weed.

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Expansion of the range of the Red-necked Wallaby in south-west Victoria

The Red-necked Wallaby *Macropus rufogriseus* is generally seen in woodlands where there is shrub cover, or on the fringes of forests. The species was thought to be substantially affected by past rabbit poisoning practices in woodlands and bushland reserves. It also appeared to be less common in its former haunts following the advent in the 1980s of the Black Wallaby *Wallabia bicolor*, which now occupies habitats from rocky ranges to wetland fringes or beach frontage. Visitors to Griffith Island at Port Fairy often see this species browsing on the introduced Shiny Leaf *Coprosma repens*, even wading in a pool to reach a favoured shrub.

The Black Wallaby was recognised for the first time in the Grampians in 1979 (Bird 1981). By 1987 it was seen in the Mount Napier State Park and at the Fulham Streamside Reserve on the Glenelg River near Balmoral. By 1992 it was a common sight in and around Hamilton (Bird 1992) and that situation continues, the wallabies exploiting any areas that provide dense cover (e.g. sightings in February 2011 at Lake Linlithgow and on the disused Hamilton-Coleraine Rail Reserve at Bochara). This species was previously unknown in the region, unlike the Red-necked Wallaby, which was often seen north of Hamilton (e.g. Grampians, Dundas Range, Fulham Streamside Reserve, Beear and Rocklands State Forests); west of Hamilton (e.g. Dergholm State Park, Hotspur State Forest, Weecurra State Forest); and, along with the Black Wallaby, south of Hamilton (e.g. Cobboboonee National Park, Lower Glenelg National Park, Pallisters Reserve near Orford, Homerton State Forest south of Mount Eccles National Park). Kay Aldridge (pers. comm.) from Heywood suggests that the Red-necked Wallaby is now common in the Cobboboonee forest, Homerton and Mount Clay, but tends to be encountered in small family groups rather than singly, as is usual for the Black Wallaby.

The first indication of a change in the range of the Red-necked Wallaby was the sighting of several animals on the summit of Mount Rouse, the scoria cone at Penshurst, on 17 March 2007. This was most unexpected as the habitat seems to be atypical and the species was previously unknown there. The nearest bushland source is the Grampians, 25 km to the north. Unlike the Black Wallaby or Eastern Grey Kangaroo *Macropus giganteus*, both of which were also seen at Mount Rouse, the Red-necked Wallaby is not generally known to travel across open country far from shelter. How did they get to Mount Rouse?

The Red-necked Wallaby is recorded as a sub-fossil in bone deposits found in the Byaduk Caves (Wakefield 1964). The species was not recorded in surveys conducted from 1974 to 1995 in the contiguous volcanic landscape of Mount Napier State Park (Bird 1997), or on subsequent visits to the park up to 2010. It was a surprise therefore, to see three animals in the State Park on 16 January 2011, when driving along the Cole Track. One adult remained on the track for a minute or two, no more than 15 m distant from our vehicle but, at different sites, the others moved speedily into the dense Austral Bracken *Pteridium esculentum* in this open Manna Gum *Eucalyptus viminalis* forest. Where did these new arrivals come from?

One possibility is that the wallabies may have come from distant sites to Wildlife Shelters in the area. There are two shelters currently operating. Pam Turner (Wildwood Wildlife Shelter) on the Dunkeld–Moyston Road has had a marked increase in numbers of orphaned Red-necked Wallabies at her shelter (eight in the last twelve months), but fewer Black Wallabies. The wallabies are ultimately released in the Grampians by transporting them there or by 'soft release', where the animals eventually leave the premises when they choose to do so. Blue Gum plantations provide cover and presumably most animals re-enter the Grampians National Park or bushland adjacent to the park. However, it seems unlikely that the Mount Rouse animals were derived from that source, which is 35 km distant across open country.

Robyn Richardson runs a wildlife shelter at North Byaduk and uses a similar 'soft release' policy. Again, many more Red-necked Wallabies have been cared for in recent years, with a lesser number of Black Wallabies. The Red-necked Wallabies are mostly derived from the Heywood, Mount Eccles and Homerton area. In this case the released wallabies could easily find their way to the stoney rise areas of the Harmans Valley and Mount Napier State Park, only 3 km distant.

A second possibility is that the Red-necked Wallabies from forests 25 km west of Mount Napier or from Mount Napier to the south (I saw the species there on 21 May 2011) are using the cover of Blue Gum *Eucalyptus globulus* plantations, established in south-west Victoria from 1997 (Bird 2004), to migrate to new habitats, including Mount Napier. From 1997 to 2003, 100 000 ha of Blue Gums were planted on farms (Bird 2004), with a concentration in the higher rainfall areas such as Byaduk, Macarthur, Branxholme and Digby. By 2007 that total increased by about 30%, after which the major prospectus companies failed and the industry faltered. The planting provided corridors and 'stepping stones' that wildlife might use to migrate across a previously cleared landscape. Whether that could be the case for the Red-necked Wallaby population at Mount Rouse, 20 km east of Mount Napier, is doubtful, since there are no plantations nearby and there is a much greater discontinuity of cover on the cleared farmland.

It seems probable that Red-necked Wallabies have been deliberately released at Mount Rouse, where there is sufficient cover from planted trees, shrubs, garden weeds and remnant Tussock Grass *Poa labillardierei* to sustain the small population. Whatever the cause, it will be interesting to see what areas they will colonise in future years, or if they can retain a presence in the 'newer volcanics' landscape of the Mount Napier State Park.

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Forty-three years Ago

Friendly Rock Wallabies

These interesting notes are from Mr. A. G. Fellows of Alabama Hill, Charters Towers, North Queensland.

Over a period of twelve months we have won the trust of over thirty rock-wallabies that, instead of stampeding up our rocky hillside as once they did, now sit near our tool-shed door both in the early morning and late evening; or if not in sight, come bounding down just touching the rock tips when called by my wife or me as we break up stale bread loaves to throw to them. Soon the majority are sitting up straight, bread in paws, daintily though noisily munching away, heeding us very little, so that we often stand part surrounded by them, watching their antics. Occasional fights and chases occur between some individuals, whilst others make cat-like toilets after eating, and others drink daintily from the enamel water bowl which is often refilled for them.

From *The Victorian Naturalist* **LXXXV**, p. 90, April 4, 1968

Pademelons in Wilsons Promontory National Park

In 2008 I had an article published in *The Victorian Naturalist* that explored the question: Are kangaroos indigenous to Wilsons Promontory National Park? (Whelan 2008). Nearly all available evidence led to the conclusion that they were not but there was one record that indicated kangaroos were present in the early part of the 19th century. This record was an article in the *Medical Journal of Australia* (Bird 1926) that recounted a walking expedition undertaken by Fred Bird in 1879. In his account of the expedition, Bird remarked on the presence of kangaroos around the Yanakie Homestead near the current park entrance.

This observation was puzzling, given all other evidence indicated there were no kangaroos on Wilsons Promontory until they were introduced in 1910. In my 2008 article, I provided a number of reasons why this single comment may have been out of context or the product of a failing memory. However, perhaps a more likely reason is that the animals identified by Bird as kangaroos were in fact pademelons.

The Tasmanian (Rufous-bellied) Pademelon *Thylogale billardierii* was apparently very common in coastal scrub, (such as the vegetation on the Yanakie Isthmus) at the time of European settlement; it was probably extinct from the mainland by the early 1900s (Seebeck and Mansergh 1998). They are still common in Tasmania and on some of the Bass Strait islands (Menkhorst 2008). It isn't clear how many animals were present in Victoria but there are estimates of Pademelons in their thousands near Lakes Entrance (Gullan 2010).

There are few historic records of pademelons on the Prom. An unknown number were released between April 1911 and July 1914. It is possible that they came from Flinders Island where they are still common and abundant. (Seebeck and Mansergh 1998). These animals did not establish, presumably succumbing to foxes and excessive burning. A skull was found in the dunes behind Oberon Bay during a mammal survey in 1971 (Hyett 1971). This could have been washed in from a fisherman's cray pot.

Before native species became familiar to European settlers it was not uncommon for people to use a single name to refer to animals that appeared similar. I understand that even today, in areas where they are still prevalent, pademelons are regularly called kangaroos. There is thus a good chance that Bird was referring to pademelons when he commented on the presence of kangaroos in 1879. If that is the case then this refutes the one and only piece of information that indicates kangaroos may have been indigenous to Wilsons Promontory National Park.

Acknowledgements
Thanks to David Cheal for making the initial suggestion that Bird may have been referring to pademelons.

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Toe-twitching in juvenile Sudell's Frog *Neobatrachus sudelli*

A recent article by McFadden *et al.* (2010) describing the occurrence of a curious toe-twitching behaviour in the Corroboree Frog *Pseudophryne corroboree* has prompted me to report observations I had made of an apparently similar behaviour in Sudell's Frog *Neobatrachus sudelli* 26 years ago. At the time the observations were made I could find no reference to this behaviour in the literature on Australian frogs and considered it to be an involuntary pre-feeding response of little importance. Reports of the occurrence of toe-twitching in frogs are not new (Murphy 1976, Radcliffe *et al.* 1986, Bertoluci 2002, Grafe 2008) but a recent literature review documented its occurrence in a small number of frog and toad species from a broad range of families, suggesting that it is potentially widespread within the Amphibia (Sloggett and Zeilstra 2008). To date the behaviour appears to have been reported in only two Australian frog species *Pseudophryne bibroni* and *P. corroboree* (McFadden *et al.* 2010) and its functional significance remains unclear, although this has been rigorously tested in only one species (the Cane Toad *Rhinella marinus*, formerly *Bufo marinus*; Hagman and Shine 2008). I describe the circumstances of occurrence and the nature of toe-twitching behaviour in juvenile *N. sudelli*.

Neobatrachus sudelli (formerly *N. pictus*) is a 50 mm burrowing frog found throughout the drier regions of Victoria where it is typically only met with after substantial rain that stimulates both emergence and breeding (Littlejohn 1963, Hero *et al.* 1991: 78, Barker *et al.* 1995: 224, Cogger 2000: 90, Anstis 2002: 228). During dry spells it forms a cocoon around itself of multiple epidermal layers, and aestivates below the ground (Withers, 1995). The captive maintenance and breeding of *N. sudelli* has been documented and the larval morphology and phenology have been described (Martin 1965, Gollmann 1995, Anstis 2002: 228-230), however little else has been recorded of the species' natural history.

In mid-August 1985 small portions from several clumps of *N. sudelli* spawn were collected from a private property in the township of Amphitheatre, central Victoria (143°24'E, 37°11'S, 276 m ASL). The property was formerly (in late 19th and early 20th century) the site of extensive alluvial gold mining and comprised numerous mounds (mullock heaps 2–3 m high) interspersed with hollows that retained water following rain and formed small ponds. It was at the time used for sheep grazing and had been entirely cleared of trees. Ground cover was minimal except in the hollows where grasses and sedges grew. In between the mounds grasses were cropped nearly to ground level and the only available ground cover was a few decaying logs and old fence-posts that were used as refugia by frogs and small reptiles. Recent rain had half-filled the ponds (to a depth of approximately 300 mm) and had triggered breeding in both *N. sudelli* and Ewing's Tree Frog *Litoria ewingii*.

Spawn was collected using a small dip-net, placed in a plastic container and later transferred to a glass tank containing 10 litres of tap water that was replaced weekly. The tank was housed indoors near a large north-facing window where it received natural light. Water temperature varied from 15 to 22°C. Eggs hatched after approximately two weeks and 60 larvae were retained and fed on a diet of freeze-dried tubifex worms, fish flakes and boiled lettuce. Metamorphosis commenced 44–60 days after collection at total lengths 45–65 mm and took two to three weeks to complete. Metamorphlings had snout-urostyle lengths between 15 and 25 mm ($\bar{x}$= 22 mm, n = 60). The observations below were based on only 10 juveniles that were retained and these were housed in two plastic containers with moist sphagnum moss. Several adult *N. sudelli* were at the time also maintained in captivity in a glass tank containing a 10–15 cm depth of moist loam soil. All juveniles were eventually released at the point of capture following rain.

Juveniles were maintained on a diet of chopped earthworms and small mealworms, supplemented with other small insect prey such as slaters *Porcellio scaber* and small moths when available. In order to ensure all juveniles fed, individuals were removed from their containers and placed on a flat surface in clear view of prey items. Typically, toe-twitching (more accurately described in this species as toe-*wriggling*) was initiated within approximately 15 seconds of the food item starting to move. Toe-twitching involved relatively rapid and repeated vertical movements of the toes on the rear limbs. The twitching appeared to result from wave-like movements that commenced near the base of the foot and propagated forward to the toes, resulting in their being lifted clear of the substrate. The toes of both rear feet were twitched simultaneously while the head and body remained completely still. Toe-twitching was never initiated in the absence of food items and ceased once the frogs had lunged at the item. It was typically repeated a second, and sometimes a third time, when additional prey were offered. All juveniles (n = 10) were observed to toe-twitch in response to moving prey items but none were observed to toe-twitch when presented with stationary (dead) prey. Juveniles were quite vigorous feeders but often inaccurate in their initial strike at prey. They were also awkward in their handling of larger prey and would frequently use the front limbs in an attempt to restrain the movement of prey that was protruding from their mouths. Occasionally, the frog would press its mouth (containing partially swallowed prey) against the substrate and other objects in the enclosure by a vigorous jerking action of the rear limbs.

I cannot recall with certainty whether toe-twitching occurred in adult *N. sudelli*. Adults were fed at night when they were active under subdued lighting and food items were left in the enclosure resulting in their feeding not being regularly witnessed. Gollmann (1995) maintained and bred this species in captivity for about six years but makes no mention of toe-twitching behaviour. I have not observed toe-twitching in the Growling Grass Frog *Litoria raniformis* nor the Eastern Banjo Frog *Limnodynastes dumerilii dumerilii*, both of which I had maintained in captivity for some years.

On the basis that prey movement is the primary cue used by amphibians to detect and to localise prey, Sloggett and Zeilstra (2008) proposed that toe-twitching behaviour acts as a vibrational stimulus to keep prey moving. To date this hypothesis remains untested. While it is possible that toe-twitching in *N. sudelli* (and other frog species) may function as a vibrational stimulus, or perhaps as a lure to some prey, it may alternatively have no function and simply represent the external manifestation of the frog's internal state: namely, one of anticipation or anxiety in response to moving prey. It is obviously useful to have a detailed knowledge of a species' natural diet in attempting to determine which of these explanations may be correct. The natural diet of both juvenile and adult *N. sudelli* is not known; however, its congener the Trilling Frog *N. centralis* was found to most commonly feed on ants and termites (Read 1999), invertebrates which tend to move constantly when in the open.

Given the occurrence of toe-twitching behaviour in both *Neobatrachus* and *Pseudophryne* it is likely that this behaviour is more widespread within the Myobatrachidae. Hopefully the observations described above might prompt naturalists to report their observations on either the occurrence or non-occurrence of toe-twitching behaviour in other frog species.

Acknowledgements

The author gratefully acknowledges Michael McFadden (Taronga Zoo) for providing many of the references. Thanks are also due to Val Turner for making the effort to locate my notes on this species, and to the Dryden family of Amphitheatre for their friendship and hospitality over many years.

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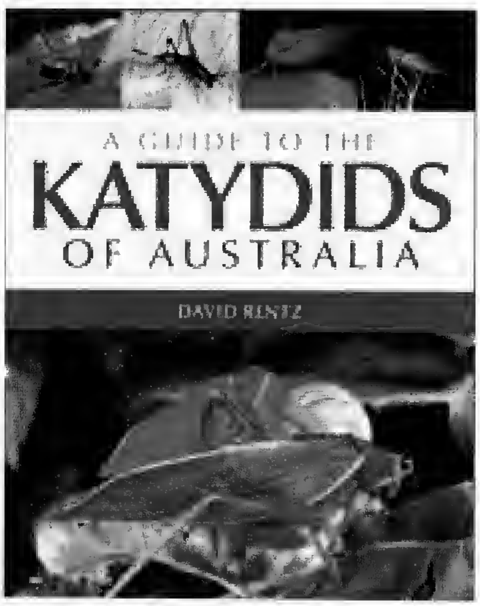
A Guide to the Katydids of Australia

by David Rentz

Publisher: *CSIRO Publishing, Collingwood, 2010. 214 pages, paperback, colour photographs ISBN 9780643095540. RRP $49.95*

If the question 'what is a katydid?' was posed to many Australians, it would result in a blank stare or, as I often hear, the response 'some kind of cicada'? It seems that although many of us live with these intriguing insects in our very yards, they are not a well-known group at all. Even when people come face to face with these insects, they are more often than not identified as 'green grasshoppers'. The author David Rentz certainly does know this group well; after all, his life has been spent studying this particular group of orthopteran insects. Long after his retirement from CSIRO he continues to channel his energies into this group of insects, the Tettigoniidae, which he is most passionate about.

This book is another excellent title in CSIRO's guide series. It is rich with high quality images and structured quite well. It is more focused than the other titles, however, featuring just one family. This is by no means a limitation as potentially there are 1000 species within this group. So, as with most invertebrate guides, it is practically impossible to cover all species within any given topic. Besides which, the author continues to describe new ones!



The introductory section takes readers through a detailed overview of katydids, and differentiates them from some of their close relatives such as crickets and grasshoppers. Fascinating facts about the family are revealed, and an overview of the diversity within the Tettigoniidae is provided. It is evident within this introduction that the author assumes the

reader has a reasonable level of biological and entomological understanding. This certainly doesn't exclude the layperson, but those new to entomology will need to use the glossary provided.

Chapter two examines katydid biology, covering reproduction, feeding, and even provides an insight into the predators and parasites that rely on this group of insects. Sound and hearing (Chapter three) explains in detail how and why katydids create the sounds that are as much a part of the Australian summer as those of cicadas. Chapter four provides an insightful look at collection and study techniques. Some very valuable tips can be gained here for those looking at studying this family. These are complemented by Chapters five and six, which cover habitats and conservation.

The body of the book, of course, is the guide to species (Chapter seven). This large family is broken into 14 subfamilies. The order of presentation follows a traditional phylogenetic scheme: the more primitive groups are listed first, followed by more advanced. Each of the 14 subfamilies is broken down to genus and species level and where applicable the larger subfamilies also include tribe and subtribe levels.

Each species listing is accompanied by a paragraph of text on known distribution, as well as details about characteristics such as behaviour or physiology that would aid identification. Colour photographs are provided adjacent to the description of each species. There appears to be no set formula to the layout of the species descriptions and accompanying photographs; however, the locations and labelling of images makes it quite simple to match them up quickly. The publication uses photographs of the various species in their habitats, as illustrations, which I find much more helpful for identification purposes in the field than photographs of faded preserved specimens.

A useful key to the 14 subfamilies is provided at the end of the species guide, along with a list of the Tettigoniidae of Australia. A three-page glossary is included and is vital for those new to the field. Appendix 1 presents a quick overview of keeping katydids alive and of preserving specimens, and Appendix 2 lists special interest groups and entomological supplies. While Appendix 2 is useful now, it is likely to date reasonably quickly.

This is an excellent book, and the only guide available on this specialised group of insects. Needless to say, for those interested in this group it is a must-have item, whether it is for formal study or to find out which species is calling from the shrub in the backyard. It is nicely presented and for the most part very user friendly.

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Fifty-two Years Ago

A Dyed Grasshopper

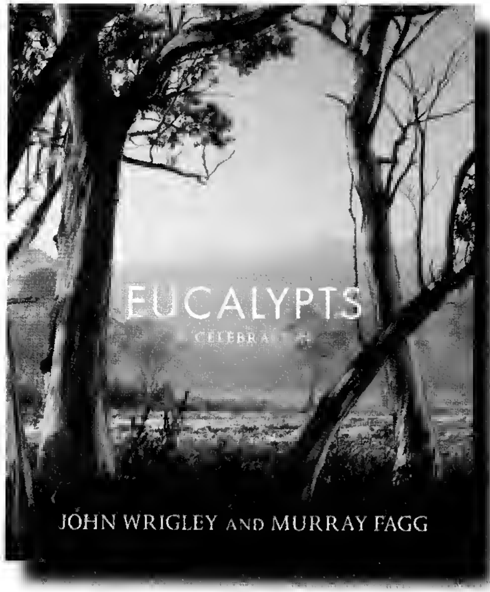
Miss Joan Ridsdale, of Camberwell Girls' High School, sent a small red grasshopper and a battery of questions regarding it. It was a second-stage nymph of *Caedicia valida,* one of the common species of "long-horn" grasshoppers. The adults are usually referred to as katydids; they are green and have large wings. Katydids are not pests. The interesting thing about this particular nymph was its *red* colour, and, when the matter was put to Mr. A. N. Burns of the National Museum, he suggested that it had been feeding on something pink, possibly young rose shoots.

From *The Victorian Naturalist* LXXVI, p. 185, November 5, 1959

Eucalypts: a celebration

by John Wrigley and Murray Fagg

Publisher: *Allen & Unwin, 2010. 352 pages, hard cover, colour photographs. ISBN 978 1 7417592 4 2. RRP $65.00*



It is important to note the subtitle of this book. Without it, one might imagine that this is another book which just describes and illustrates many of the 700-plus species of eucalypts.

However, in its 340 pages with beautiful photographs, the book looks at eucalypts from every conceivable angle. The cover blurb sums it up very well:

> This book celebrates their diversity, their beauty and the role they play in our history, culture and economy. It looks at their evolution, biology, horticulture and ecology, together with their classification and the botanists involved. Through historic and contemporary images, it examines the many ways in which they have served Aboriginal, colonial and contemporary Australians in both practical and aesthetic ways.

It does this in six parts and 38 special-focus chapters—far too many to list here. In addition, there is a checklist of 758 species plus 151 subspecies listing information under the headings: naming author(s), date described, geographical occurrence, tree size, flower colour, and the meaning of the name—this appendix is a valuable reference resource in itself. By the way, it should be noted that the general term 'eucalypts' includes the three genera *Angophora*, *Corymbia* and *Eucalyptus*, and all are dealt with in the book.

This is not the sort of book that you attempt to read from cover to cover. You can dip into any chapter and find fascinating, thoroughly-researched and well-illustrated information on many diverse aspects, for example: eucalypts as wildlife habitat, botanists who named eucalypts, eucalypts in wartime, managing pests and diseases, timber crafts, dyes, eucalypts overseas, eucalypts in advertising, eucalypts and children, eucalypts in Australian literature, and much more.

One reference under Significant Individual Eucalypts will be close to the hearts of Victorian bush-lovers. It reminds us that, along with the human casualties of the 2009 Black Saturday fires, there was the loss of the whole Mt Disappointment forest of giant Mountain Ash *Eucalyptus regnans*, including Big Ash One which stood at 92.4 metres in Kinglake National Park. Mountain Ash regenerates only from seed, so it will be several human generations before such trees can again be seen in that forest.

I found this book absorbing and easy reading, with clear detail where it was needed. It has been very well written, designed and edited, its taxonomy is up-to-date, and I haven't noticed any errors. It can give hours of reading pleasure to anyone—not just botanists. I wholeheartedly recommend it.

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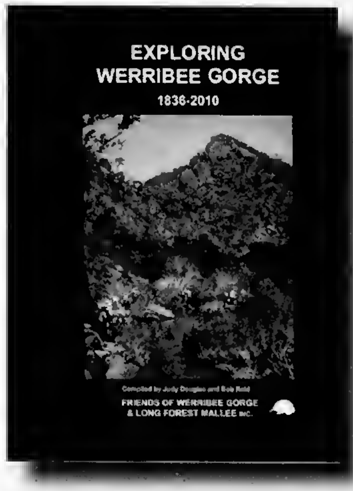
Exploring Werribee Gorge 1836–2010

compiled by Judy Douglas and Bob Reid

Publisher: *Friends of Werribee Gorge & Long Forest Mallee Inc., Bacchus Marsh, Victoria, 2010. 320 pages, paperback. ISBN 9780958120050. RRP $32.00.*



Exploring Werribee Gorge 1836 - 2010 is the latest in a series of books published by the Friends of Werribee Gorge and Long Forest Mallee Inc over several years. Previous books detail the natural history of various sites in the Bacchus Marsh area in which the group has an active interest. This latest book documents the history of human interaction with the Werribee Gorge. It demonstrates that the Gorge's unique geological features were recognised in the earliest days of European settlement in Victoria.

Using primary sources that document the history of human interaction with this fascinating place, combined with photographs taken over 160 years, the book demonstrates both the public and official interest in the Gorge since the early days. These documents include reports from government departments, newspaper articles, hand-drawn maps, reviews, letters, early black and white photographs and naturalists' reports. The black and white format of the book reflects the nature of these documents and material. Bob Reid's distinctive drawings of plants and wildlife effectively complement the style of the book.

The book documents a long association of the Field Naturalists Club of Victoria with the Werribee Gorge. There have been regular visits by the Field Naturalists Club of Victoria to the Gorge since at least the 1890s, reports of which have appeared in *The Victorian Naturalist* for over a hundred years. It also describes the long involvement of noted naturalists such as AJ Campbell and JA Leach with the Gorge.

Local newspaper articles describe Dr JA Leach, and others, leading parties of 500-700 students on educational excursions into the Gorge, as early as 1906. This would be a daunting exercise in these days of universal vehicle ownership, let alone in the days when cars were a rarity and travel was invariably by train.

Excursion notes reveal that there existed a different approach to bird-watching in these pioneering days. One report states: 'the number of birds identified was exactly 50 species, nests and eggs being taken of 19' (page 18). A similar statement nowadays would horrify most birdwatchers.

Despite early recognition that the Gorge was worthy of protection, the book details the slow and tortuous process by which a reserve was created. A letter to local newspaper *The Express* on 15 April 1939 reflects local frustration on lack of progress in creating a reserve at Werribee Gorge:

> There is a story that a parrot was sent from Mildura to Benalla… On arrival in Melbourne the bird was found to be dead and an unusually efficient officer wrote on the address card "Bird dead". On arrival at Benalla another official not to be outdone added: 'Bird still dead. Has a similar fate befallen the Gorges?' (page 142)

The region to the west of Melbourne and its fascinating natural history have long been neglected by the wider community. 'Nothing but weeds and Brown Wedges' are commonly expressed perceptions. This series of books by the Friends group plays an important role in promoting interest in the natural history of this region, especially in a climate of rapid expansion of the urban growth boundaries of Melbourne's west. Their latest book details not only the history of the Werribee Gorge, but also gives an insight into the history of the Bacchus Marsh region.

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Mistletoes of Southern Australia

by David M Watson; Illustrations by Robyn Hulley

Publisher: *CSIRO Publishing, Collingwood, Victoria, 2011. 200 pages, paperback. ISBN 9780643095939. RRP $49.95*

At long last we have a book on the wonderfully fascinating mistletoes of southern Australia. I opened this book with a great deal of anticipation and pleasure and I have not been disappointed. David Watson and Robyn Hulley have together produced a book that deals not only with the identification of mistletoes, but includes also their biology, ecology, cultural significance and management. It informs the land manager and field naturalist and tells them all they need to know about these plants that have evolved the semi-parasitic way of life. The watercolour illustrations of all species make this a beautiful book as well.

The author aims to raise awareness of these 'distinctive and beautiful native plants'. He aims to dispel some of the misunderstandings and unfounded beliefs that these plants are toxic, that they are not native to Australia and they kill trees. I think he achieves these aims and we are made aware of the fascinating biology and ecology of these plants. Clearly, they contribute significantly to the biodiversity of our bush and landscapes. Several honeyeaters rely on mistletoe nectar; the Mistletoebird feeds on the fruit – and distributes the embryo. There are insects such as the Imperial White butterfly and the Mistletoe Moth that depend on mistletoes as food plants for their larvae.

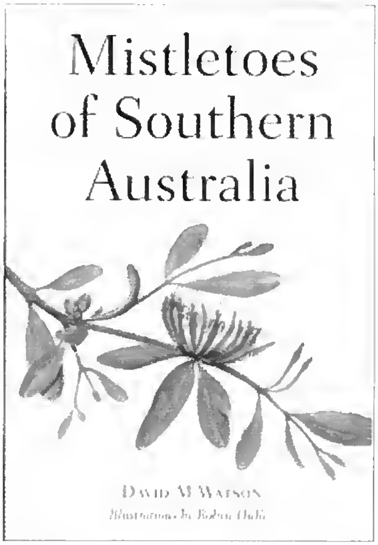
In his Preface, the author points out that

> … A great deal has been written about Australian Mistletoes, but this material is difficult to access and beyond the reach of most people. Detailed species descriptions, identification keys and distribution summaries are available in the national and state-based Floras ...

This is obviously true, but in my view it undervalues the capacity of the keen land manager or the enthusiastic field naturalist to cope with the more technical aspects of plant science. However, he has brought together a mass of scientific information and presented it in a very accessible and readable form. A similar approach was taken by the Field Naturalists Club of Victoria in the early 1990s with the Forum on Mistletoes in Victoria (proceedings published in *The Victorian Naturalist* 1997).

Descriptions of the 46 species found in southern Australia (below the 26th parallel latitude) comprise a significant section of the book (a checklist of all 91 currently recognised mistletoes of Australia is given on pages 173-175). They are arranged in alphabetical order, genera and species. Each species is described with the diagnostic characteristics highlighted in bold type. Distribution, habitat type, main hosts and associated species are described and there is a photograph and a distribution map, all on the same page. The page is headed by the botanical name and the most accepted common name; alternative common names are also given. Given that keys to mistletoe identification are given in the different state Floras, I feel a key would help readers to identify a particular species without having to thumb through all the descriptions.

Opposite this descriptive page is a full-page watercolour illustration of the species by Robyn Hulley. These illustrations are a major contribution to the beauty of the book and certainly help in the process of identification. Unfortunately in a few instances the detail structure of the inflorescence or flower are not clearly visible and there would be justification to make a larger, separate illustration of these structures. For instance the detailed floral structure of *Nuytsia floribunda* is not clear, and individual drawings of the difference in floral arrangements in the triads of *Amyema pendulum* and *A. miquelii* would greatly assist in identification of these species. The flowers of members of the Viscaceae are very small and play little part in the identification of species, the habit illustrations are beautiful, but I would like to see, again through a magnified illustration, the details of the flowers of this group.



There are few typographical errors to detract from the flow of the language. Probably the most irritating one to the author and publisher would be on the Content page where the Viscaceae is listed as Visaceae.

All in all, this is a wonderful book and I recommend it strongly to all land managers and field naturalists. To all bushwalkers and gardeners in southern Australia, this is a book of interest and will, no doubt, deepen your appreciation and love of the Australian bush and landscape. In some situations management and control of mistletoes is necessary, and the book gives clear advice on how such management can be achieved. Congratulations to all concerned.

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Forest Phoenix: How a great forest recovers after wildfire

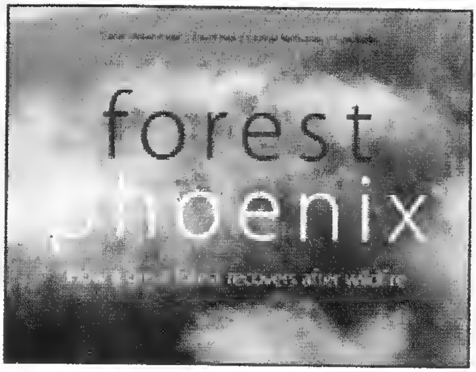
by David Lindenmayer, David Blair, Lachlan McBurney and Sam Banks; Photography by David Blair

Publisher: *CSIRO, Collingwood, Victoria, 2010. 128 pages, paperback. ISBN 9780643100343. RRP $39.95*

This is such a good book. I know that a reviewer should avoid such emotive language, but it couldn't be helped. This is such a good book.

The logical sequence of the book is compelling, starting with an introduction based around the 2009 wildfires in the tall montane forests immediately north and east of Melbourne. The reader is led from a gut reaction at the fires' ferocity and apparent destructiveness, into an appreciation of the characteristics of such huge conflagrations and the post-fire environment. The next chapter is a positive ramble through forest regeneration, thence to animal recovery. The last chapter discusses the various changes that human settlement has brought to these forests — changes in the ecological impacts, intensity, ubiquity and long-term effects of our involvement with these forests. As a result, the reader is led into the contentious issues (fire management, logging, carbon storage, water yield, biodiversity conservation) only after considerable insight into forest processes has been gained. This is an even-handed and informed consideration of the issues involved in these forests. Polemic and partisanship are virtually non-existent, allowing readers to bring their own perspective to a consideration of these issues. Would that all political controversies were so carefully, thoughtfully and respectfully treated.

The illustrations are a highlight of the book. 'Every picture tells a story' is as true of the illustrations in this luxuriously illustrated book as it was of *Doan's Backache Kidney Pills* in the early 20th century (an early origin for this phrase). In *Forest Phoenix* the pictures are of consistently high quality and none is wasted. The story each picture tells is amply illuminated by the brief but informative text that accompanies each. Indeed, the book is so lavishly illustrated that it's close to a 'coffee table' format and most determinedly not intimidating for the vast majority of us who are not at the forefront of scientific research (as these authors clearly are). Al-



though each picture is clearly included on the basis of the story it tells or illuminates, so many of the pictures could just as easily justify their place in a book on photography as art. With very few exceptions (e.g. page 65, as discussed below), all pictures are remarkably consistent in format and composition. The book is a coherent whole.

Of course, those of us with a long-standing interest in some aspect of natural history will find some gaps in the story told through these pages. This reviewer would have appreciated more consideration of the ecological effects of seed banks, plant regeneration and growth and the options that are available to landscapes. For example, a consideration of why Mountain Ash trees can only regenerate after fires seems a bit of an oversight (their seeds are so small, have so little stored 'food', that they must be self-supporting and photosynthesize almost as soon as they germinate, hence they cannot make it through the dense shady vegetation of these forests ... except for that rare opportunity when sunlight gets right down to the forest floor, i.e. straight after fires). But this is nit-picking. Everyone with some familiarity with these forests would shade their story differently. This book is intended not as the last word, but as an introduction. It is eminently successful.

Those of us wishing to interrogate the scientific literature further have been provided with a reference list, but this book is *not* intended as a scientific treatise. The flow of the narrative is not broken by embedded references, charts or tables. There is only one diagram (and even that looks, at first glance, like another photograph). On page 91 the mention of 'our research ...' overlooks the contributions of so many others who have contributed to the ecological understanding of these forests, but, on the whole, the narrative is gratifyingly impersonal. This book is a story of the forests themselves, not of the researchers nor other workers who have spent so much time therein.

Errors are few, but the following warrant attention:

p. 7 – Red Stringybark rarely occurs in admixture with the other eucalypts listed. Instead it prefers drier sites;

– 'Snow Gum Woodland' is the name often given to stands of *Eucalyptus pauciflora* and the associated plants. However, the photo well illustrates that this vegetation type rarely (never in the Central Highlands of Victoria) forms a true woodland (widely-spaced trees);

p. 17 – ' ... the vast majority of which **was** killed';

p. 31 - '.. as **burrs** in fur ... ';

p. 65 - The lower photo is doubtfully *Antechinus agilis*. It looks more like *Sminthopsis leucopus*, or some other *Sminthopsis* species;

p. 111 – 'subsp.' is the appropriate abbreviation for 'subspecies', not 'ssp.';

p. 112 – The Black Wallaby is usually known as *Wallabia* ***bicolor***, not *Wallabia unicolor*.

On a nomenclatural note, it is pleasing that English names for all species are capitalized (as is usually the preference of biologists). There is no option for mammals and birds, but it is gratifyingly consistent that English names of other organisms are also capitalized.

In summary, this book is unreservedly recommended. It is informative, authoritative, comprehensive, accessible and almost as enjoyable as a ramble through these forests themselves. How useful it would be if all our habitats were introduced and explained with such elegance and simplicity.

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